

THE  
AMERICAN JOURNAL  
OF THE  
MEDICAL SCIENCES.

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ARTICLE I. *Observations on Cerebral Auscultation.* By JOHN D. FISHER, M. D. (Read before the Boston Society for Medical Improvement, March 26, 1838.)

IN the summer of 1833, as many who are now present will recollect, I read a paper before this association, on the subject of a *cephalic bellows-sound* which I had discovered to accompany certain diseases of the brain. From the fact of this sound being detected in the head by means of auscultation, I denominated it the *cephalic bellows-sound*. In speaking of this symptom at that time in connexion with the pathological condition of the organs which evidently gave rise to it, I expressed the opinion that auscultation might hereafter prove to be an important means of diagnosis of cerebral, as well as thoracic diseases, and that the cephalic bellows-sound might turn out to be a pathognomonic symptom of affections of the head. Since expressing that opinion, I find from observation that certain audible murmurs are constantly being developed within, or passing through the head; and that the head, therefore, as well as the chest, presents all the conditions necessary to render auscultation available in investigating its diseases. In this communication, I shall speak of these normal murmurs, and shall then call your attention anew to cases in which a cephalic bellows-sound was heard; and lastly, shall offer an explanation of its causes. Before proceeding to describe the normal cephalic sounds, I will remark that all the directions which have been laid

down by authors for the employment of auscultation in diseases of the chest, should be our guide when we are to auscultate the head. In fact, the sounds which take place in the chest are more distinct and more readily caught by the ear, than those are which occur in the head; every possible caution, therefore, should be taken by the auscultator, that all obstacles should be removed which might embarrass him in his examinations.

In auscultating the head, mediate or immediate auscultation can be practised. But since the head is spherical, and can be readily and conveniently approached by the naked ear; and since the ear, from its peculiar shape and flexibility, may be more perfectly applied to the surface of the cranium than the stethoscope can be, I prefer to employ immediate to mediate auscultation, and consider it the more simple and the more satisfactory method of the two.

In practising cerebral auscultation, the person to be examined should be in a horizontal position, with his head supported by a pillow. If it be a child, the examination can be more satisfactorily made while it is asleep than when awake; for while the child is asleep its head can be approached without danger of causing it to cry or to become restless. The head to be examined should be covered by a cap, napkin, or some soft covering. Such a protecting medium will prevent any noise which without it might arise from the friction of the hair against the auscultator's ear and head. By attending to these precautions I can, by applying my ear to the heads of healthy children, hear a sound which is evidently produced by the impinging of the air against the walls of the nasal cavities during the act of respiration. It commences and terminates with the respiratory act. This sound is peculiar, and is readily recognised. It is the one which first attracts the attention, and resembles in all respects, except in intensity, the respiratory murmur caused by the air passing through the nostrils when the mouth is closed, and which is then audible to the person breathing. This sound, which I would denominate the *cephalic sound of respiration*, is heard rather more distinctly during expiration than inspiration; and becomes somewhat modified when the membrane of the nose is affected by a cold or other cause. A second sound which strikes the ear is one whose impulse seems to be transmitted from a distance. It is evidently that of the heart, and is a soft mellow sound, resembling that produced by softly palpating our cheeks when distended by air. It corresponds with the action of the heart, and varies in frequency and intensity as the contraction of that organ varies in rapidity and power. It may be called the *cephalic sound of the heart*. The cephalic sound of respiration and the cephalic

sound of the heart are the only sounds which auscultation discovers in the heads of healthy children when they are asleep or at perfect rest. If, however, the child should cry, or speak, or swallow whilst the ear is applied upon its head, then other sounds may be heard. When the child cries or speaks, the sound of its voice is very distinctly heard at the surface of his head, or on whatever part of it the ear may be placed. It is generally sharp and piercing, and seems to arise out of the cranium itself, so near does it appear to be to the ear; and when it is heard through the stethoscope, it seems as if it were vibrating about the mouth, and even to pass into the canal, of the instrument. This sound I would term the *cephalic sound of the voice*. It varies somewhat in its tone and apparent approximation to the ear, at different parts of the head. At the unclosed fontanelle it is less sharp and somewhat more mellow and diffusive in its character than at any other part of the head, and seems to be further removed from the surface. The other sound which attracts the attention attends the act of deglutition. When a child swallows any fluid, a sound of a compound character is readily distinguished by applying the ear to its head. I hardly know what the sound resembles, or to what I can compare it. It is peculiar, and cannot be described; but it can never be mistaken for any other bruit after it has once been observed and recognised. It has a liquid, and a dull, massive tone, and is evidently caused by the act of deglutition. I shall therefore denominate it the *cephalic sound of deglutition*. This last named sound may be best noticed while a child is nursing—for then it is less liable to be obscured or masked by the cephalic sounds of respiration or by any movements of the head.

I have described these sounds as they are developed in the heads of infants previous to the closure of the anterior fontanelle. They become modified in some respects by the influence of growth, and the density of the brain and cranium. This is more strikingly the case with the cephalic sound of the heart. In early infancy and before the period of dentition, the cephalic sound of the heart is distinguished by a softness and diffusiveness of tone which it does not possess afterwards. In youths and adults the sound acquires a coarser and harsher tone, and seems to be more remote from the ear. The cephalic sounds of the voice and deglutition are not so sensibly affected by the growth and increased density of the cranium and its contents. All the sounds which I have now described are most distinctly heard at the summit of the cranium, although they may be easily detected at any portion of its surface. Such are the murmurs or bruits which are constantly occurring in, or traversing, the heads of healthy individuals, and

which auscultation reveals and enables us to appreciate. They unquestionably are the results of the functions to which I have referred them.

These cerebral murmurs, I find from observation, become modified by the presence of certain diseases within the cranium, and thus become symptoms of cerebral affections. This is manifestly the case with the cephalic sound of the heart. The cephalic bellows-sound which, in 1832, I discovered to accompany certain diseases of the brain, is a modification of the cephalic sound of the heart; and I beg now to direct your attention to some cases in which it presented itself as a prominent symptom.

*In the first place, I will remark, that I have found it to be a symptom of chronic hydrocephalus.* Case of Walter W. Baxter, as recorded in my note book, July 16, 1832. This child, who is now two years and seven months old, was strong and well formed at birth, and enjoyed perfect health until he began to cut his first set of teeth. The period of dentition was one of suffering and distress to him. When thirteen months old, he had cut but two teeth, and was labouring under a severe attack of cholera infantum. At eighteen months he was unable to walk, and at about this period his mother thought that his head began to assume a singular shape and to increase in size. He was removed to the country for the benefit of his health, but he remained extremely feeble for a long time. His head continued to enlarge, and a slight deformity of the spine was noticed in March last. He now, July 16, 1832, presents the following symptoms:

*External appearance.*—Body and limbs much emaciated; muscles soft, flabby; head unusually large, its scalp seems to be drawn tightly over it. The fontanelles remain unclosed—the anterior one is an inch in diameter, and is filled up by a soft, pulsating tumour, which projects slightly above the surface of the cranium. The coronal and sagittal sutures are unclosed, and the latter suture can be traced down the frontal bone to near the nose. His senses appear intact, and mental powers good; but he is unable to articulate words, and exhibits no disposition to imitate sounds. For some time past the child has been subject to slight spasms, and has at times uttered screams during sleep. On applying my ear over the anterior fontanelle, which I was induced to do from observing its strong pulsatory motions, I heard a distinct bellows-sound. This is a novel phenomenon, and has never been noticed before. The sound is coarse, abrupt, rasp-like—is synchronous with the pulsatory motions at the fontanelle, and with the arterial pulse, and occurs one hundred and forty-four times in a minute. It can be heard over any portion of the cranium, but it is

most distinct at the anterior fontanelle. While listening to this sound, I can hear a murmur accompanying his respiration, and also a sharp resonance of his voice when he cries or utters any vocal tones. These sounds are distinct from and independent of the bellows-sound, and of each other, and are constant in their occurrence. This new auscultic symptom, which may be properly called the *cephalic bellows-sound*, is confined to the head, as nothing resembling it can be detected in the heart, or great blood-vessels passing from it, or in any artery or organ below or exterior to the head.

This new symptom was first noticed on the 16th of July, 1832, and the discovery of it induced me to follow the progress of this patient's disease, and to auscultate his head whenever an occasion presented. The child remained feeble and sickly until he had cut a number of his teeth. During the year which followed my first examination of the boy, I occasionally went into the country to see him. On the 13th of July, 1833, I saw the child and recorded the following note respecting him:—The boy's health has gradually improved during the past year, under the treatment prescribed for him by Dr. Thaxter, and he is now apparently free from any dropsical affection. His head has decreased in size, and measures less than it measured one year ago. The sutures and the posterior fontanelle are closed and firm, but the anterior fontanelle is not yet perfectly ossified. The mental powers of the child do not appear to have suffered by the disease, as they are now as active and as effective as those of children of his age generally are. About four months ago he began to imitate sounds and to articulate words; and is now able to talk and pronounce his words correctly. During the course of his malady a curvature of his spine took place, which has rendered him incapable of sustaining his weight, and of walking. As the absorption of the fluid within the cranium took place, which was manifested by the gradual diminution in the size of the head, and by the closing of the sutures, the cephalic bellows-sound became less and less distinct, and finally disappeared.

The above is the last regular record that I have made of the history of this interesting case. I am able, however, to observe, that during the last four years and a half, the boy has enjoyed tolerable health, and notwithstanding his deformity caused by the curvature of his spine, he is active and vigorous. He has attended school constantly for the last three years, and is distinguished for his intelligence and the rapidity with which he acquires knowledge. This last is an interesting fact in the history of this boy—as it furnishes another proof that the existence, for a long time, of an extensive dropsical effusion around the brain in early life, does not necessarily derange the mental

faculties or diminish their power. The above case was referred to in my first paper on the subject of the cephalic bellows-sound. I have noticed this same symptom in two other cases of chronic hydrocephalus. The following is a brief account of one of them, which was also noticed on a former occasion. The subject of it has since died, and I now add to the history of the case an account of the pathological condition of the brain. The following are the notes which I made of the case on the 5th day of October, 1832. Henry Orr, aged nine years, has been sick from infancy with some affection of the head, supposed by his physician to be dropsy. The prominent symptoms, as related to me, have been—a gradual enlargement of the head; a separation of the sutures, and unossified state of the fontanelles until a late period; retarded developement of the body; frequent convulsions, resembling those of epilepsy. At the present time his head is of unusual diameter and much deformed. The sutures and fontanelles are firmly closed, and the scalp is expanded over the cranium as if by force. His eyes project very much, and appear to be thrown forward from their sockets. The left eyelid is morbidly distended, hangs loosely over and completely covers the globe of the eye. The pupil of each eye is much dilated, and that of the left is so much so that its diameter corresponds very nearly with that of the cornea. The boy, however, sees quite well, and his other external senses are normal. His mental powers, those of memory and judgment in particular, are enfeebled; and he is represented to have lost in a gradual manner the power of remembering events of daily occurrence. His appetite and digestion remain tolerably good; yet he has become much emaciated, and is now, and has been for a long time, unable to walk. On placing the stethoscope or my ear upon his head, I hear a feeble bellows-sound. This is rather loudest, I think, at the space occupied by the anterior fontanelle and along the sagittal suture, but it is audible at other parts of the head. The sound corresponds with the pulse, and is short, abrupt and coarse. The murmur of respiration is heard very distinctly, and the sound during inspiration seems to pass up through the instrument towards my ear, while during expiration it appears as if it was rushing downwards through the stethoscope, and to recede from my ear. The resonance of his voice, when he speaks, seems to be playing around the rim of the instrument, and is loud, and from its acute tone is sometimes painful to the ear.

The lad whose history I have now briefly related, died on the 1st day of March, 1835, two years and five months after the observations I have recorded were made. During this interval of time, as I learn

from Dr. Ware, of Milton, his medical attendant, he was constantly subject to convulsions, or epileptic fits, and complained of a continual deep-seated pain in the left side of his head. He gradually became more and more emaciated and feeble, losing the power of vision of his left eye; but excepting his memory, he retained possession of his mental powers to the last. A post-mortem examination of his head only was made, which exhibited the following pathological appearances, as reported by Dr. Ware. The bones of the cranium were firmly united; the dura-mater adhered strongly to the cranium, and was much thickened in spots. The convolutions of the brain were much flattened. The arachnoid and pia-mater were thickened and adhered strongly to each other and to the brain—no fluid was found within or between them and the dura-mater, or exterior to the brain. The brain itself, as a whole, was soft. The left hemisphere was much diseased; portions of the same being very hard, resembling condensed fibrous structure, and sounding like cartilage when incised. In the midst of these hard portions of the brain were found parts, of the size of bullets, in a state of suppuration. The right hemisphere, although not in a healthy condition, yet was comparatively free from disease. The ventricles were enormously distended and completely filled with a milky serous fluid, amounting to more than half-a-pint. Considerable fluid was also found at the base of the brain, and some oozed from the softened portions of the organ when cut.

*I will observe, secondly, that I have noticed the cephalic bellows-sound to accompany simple congestion of the cerebral organs.* The second case in which I detected the symptom was this: A little girl, four years of age, residing at Watertown, fell from a second story window, in the summer of 1832, and struck her head upon the brick pavement below. She was taken up senseless, and lifeless, as was supposed by her friends. I saw her while in this state by invitation of her physician, Dr. Hosmer. On auscultating her head, I at once detected the short, abrupt, rather coarse bellows-sound, which was readily heard also by Dr. Hosmer. It was independent of the cephalic sounds of the respiration and voice, and was synchronous with the arterial pulse. Active remedies were prescribed and applied through the night, and on the next morning the child appeared better. We found the bellows-sound still present in the head; but it was not so distinctly heard as on the previous evening. At my request Dr. Hosmer paid particular attention to this new symptom, and reported that "the bellows-sound continued to be heard while the excitement was active, and that it by degrees died away, as the inflammatory

symptoms abated." The child recovered from the injury, and I presume is now living.

It is but a short time since I was called to a child in Fayette street, who had fallen from a second story window upon a plank pavement, and struck his head. I saw him in one hour after the accident. He had recovered somewhat from the immediate effects of the injury, but was still inclined to sleep. On applying my ear to his head, I readily caught the bellows-sound. As in the other case, it corresponded in frequency with the arterial pulse, and was short, coarse, abrupt. In twenty-four hours the child had recovered from the effects of the fall, and no longer presented the cephalic bellows-sound. I have noticed this auscultic phenomenon very many times under other circumstances which indicated decided cerebral congestion. Every medical practitioner is a daily witness to the great arterial and cerebral excitement and frequent spasms which attend protracted and painful dentition in children. In all these cases the organs within the cranium are evidently in a state of congestion, and the brain itself is pressed upon by the congested and excited vessels which surround and enter it. Most of these cases are attended by the cephalic bellows-sound; and I doubt not but that every member of this association has at this moment under his care, children in whose head the bellows-sound may be heard. I think I may say that in six cases of painful dentition out of every ten which have come under my notice, I have detected the cephalic bellows-sound. It is characteristic, and cannot be mistaken when once observed. It is generally short, abrupt, coarse, rasp-like, and may be heard at every part of the cranium, but most distinctly at the unclosed fontanelle—corresponding always to the pulsatory motions observed at this opening, and synchronous with the heart's pulsations.

I have collected some interesting facts touching this cerebral bellows-sound attendant on painful dentition, which I think go to prove the existence of cerebral congestion, and also the valuable effect of dividing the gums for the relief of this congestion. I find that the cephalic bellows-sound, except in actual diseases of the head, cannot be detected in children previous to the commencement of dentition, and that it ceases to be heard after the teeth have pierced the gums: and in cases where there is a long interval between the successive appearance of two crops of teeth, the bellows-sound, which was developed during the cutting of the first crop, will sometimes cease during the interval, and occur again during the severe excitement produced by the cutting of the second crop of teeth. After all the first set of teeth have made their appearance, the sound dies away, and seldom



occurs during the second dentition. In three or four instances, however, I have noticed it in children during the process of the second dentition, but never in the adult except in actual cerebral disease. I have stated above that the cephalic bellows-sound disappears occasionally during the interval which occurs between the cutting of two crops of teeth. I will in this connexion observe, that I have recently noticed that the simple operation of lancing the gums may cause the bellows-sound to cease. A few days since, I was called to a child who had been subject to spasmodic convulsions caused by teething. She had just recovered from an attack of convulsions on my arrival, and was pale and exhausted, and apparently asleep. The bellows-sound was very audibly heard in her head. Her gums were swollen and tender by the protruding teeth, and I immediately divided them with a lancet. This seemed to give great immediate relief to the child, and she rested unusually well during the succeeding night. On auscultating her head the next morning, I found that the bellows-sound, which was very distinct twenty hours before, was no longer to be heard. Here was a case of cerebral congestion giving rise to spasmodic convulsions, the cephalic bellows-sound, and other symptoms; and relieved, at least in a degree, by the operation of lancing the gums. I have also noticed the cephalic bellows-sound in cases of cerebral congestion caused by hooping cough. The sound was heard at the moment the paroxysm of cough ceased, and continued but for a moment, and only while the blood-vessels of the face and head were crowded and congested by their contents. It required much cautious attention to detect the sound in these cases, as the panting of the child, and his restlessness, and the increased sound of the respiration immediately succeeding the paroxysm, all conspire to render the symptom sought for inaudible. From the observations I have made, however, I am inclined to believe that the cephalic bellows-sound is developed during every severe paroxysm of hooping-cough, and that it disappears as soon as the patient begins to breathe freely again, and the circulation becomes unobstructed.

*In the third place, I have observed the cephalic bellows-sound to accompany acute inflammation of the brain and its membranes with serous effusion into or around them.* In 1833, I made the following statement to this association: A lad aged nine years, and a child aged three, were under my care at the same time, who exhibited all the common and acknowledged symptoms of acute hydrocephalus. The cephalic bellows-sound was present in both. In the oldest boy the sound was loudest, and in both it was soft, diffused, prolonged—resembling the sound produced by the rubbing of two pieces of soft and

polished soap-stone together. At times it passed from the intermittent into a continuous murmur. This change in its character was noticed particularly during long intervals of respiration when the freedom of the circulation was in a degree obstructed. The sound in the oldest patient was also characterized by a sort of singing or buzzing, resembling that of a moscheto, and might have been denominated the musical bellows-sound of the head. The sounds in both patients corresponded with the pulse, and were heard distinctly for several days. The oldest boy was sick, or under medical treatment, twelve, and the youngest, thirteen days. In the former I detected the cephalic bellows-sound seven days, and in the latter five days, previous to their death. In both it was feeble when first heard, but it gradually increased in strength, and continued to be loud and distinct until the physical forces began to sink. It then became less and less audible in proportion as these powers failed and the force of the arterial pulse diminished.

On examining these subjects after death, a decided flattening of the convolutions of the brain was observed—the blood-vessels on the surface, at the base and in the substance of the organ, were much engorged and distended, and a considerable quantity of serum was found between its membranes, in its ventricles, and at its base. The remaining organs of the bodies were in a normal condition.

A short time after the occurrence of the cases just cited, I made the following short record of a similar disease:—June 23d, 1833. I have just examined a child by the name of Charles Bowman, aged seven months, who is a patient of Dr. J. B. S. Jackson. Dr. Jackson pronounces the disease under which the child is suffering, to be dropsy in the head. This opinion is founded on the symptoms which the child has exhibited and those which are now present, viz: drowsiness and a constant disposition to sleep, stertorous breathing, dilated and insensible pupils, spasms, &c. Besides these characteristic symptoms, Dr. J. yesterday detected a well marked bellows-sound in the head, and observed that he did not recollect of ever having heard the bellows-sound more distinctly in any case of cardiac disease. I recognised the sound at once, on whatever part of the child's head I placed my ear. It is exactly synchronous with the pulsations of the carotid and temporal arteries, and occurs one hundred and sixty times in a minute. The sound is distinct from that of respiration, and ceases to be heard on compressing the carotid arteries. The anterior fontanelle is open, and a strong impulse is seen and felt against it. The child died on the next day, and its head on examination presented the following appearances: The right half of the brain was much more

developed than the left; the convolutions of the whole organ were flattened, and the blood-vessels moderately distended. Lymph was effused under the pia-mater, and a small quantity of serum was found in the ventricles and at the base of the brain. The whole cerebral substance was soft, and yielded a considerable amount of limpid fluid on being dissected.

I will cite one more case under this head, and hope its length will not render it the less interesting or acceptable. In the evening of the 25th of February, 1835, I visited with Dr. Hildreth, a little girl aged eleven months. Dr. H. gave me the following account of her sickness. He was called to see her for the first time on the morning of the 23d, and found her feverish, breathing rapidly and laboriously, and suffering from slight cough. Her pulse 147, and number of respirations 55 in the minute. Her bowels were full, somewhat swollen; chest resounded well; lungs admitted air freely. An emetico-cathartic was administered, the cathartic effect of which continued during the night and following day; and it not being sufficiently checked on the morning of the 25th, one grain of Dover's powders was ordered to be given the child every three hours. Just after the child had swallowed the third powder, the Doctor called to see her, and found her much altered in her appearance—pulse intermittent—respiration irregular and unequal. She was apparently quite insensible, presenting the appearances which follow the taking of an over dose of opium. Dr. H. instantly ordered an emetic, which operated promptly, and caused the ejection of the last powder. When I saw the child, which was soon after the operation of the emetic, she was lying on her back, in a kind of lethargic sleep, her head resting on the nurse's arm. The following are the symptoms exhibited by the patient at that time. The child's body is warm in every part.

*External appearance.* Body plump; countenance pale; limbs lay inactive; eyelids partly open—the scalp appeared as if tightly drawn over the cranium; the temporal vein of the left side of the head, and also its branches, greatly distended, whilst the right temporal vein or its branches were not even visible. The anterior fontanelle was seen pulsating, and distended so as to project above the general surface, in the form of a rounded tumour. The movements of the chest were free, but very irregular; the abdomen was tumid.

*Touch.* The scalp felt as if it was stretched over the bones it covered; the anterior fontanelle was open to the size of a cent, and pulsated strongly against the finger at each contraction of the heart; the abdomen, though distended, was soft and yielding under the hand.

*Percussion.* The chest resounded well in every part; the abdomen yielded a slight tympanitic sound. *Respiration* frequent, irregular, 57 or about this number in a minute. The child would cease breathing for five seconds, and then take one long and deep inspiration, and five or six other and shorter, less deep, and more rapid ones; then followed an intermission of five seconds, after which the child would take a long and deep inspiration again, and five or six other ones, as before. This was the character of the respiration during the whole of my visit.

*Auscultation of the respiration.* The respiratory murmur natural in front part and left side of chest; the right side and posterior portions of the chest not examined, but there was no apparent difficulty to the free entrance or expulsion of the air into and from the lungs.

*Circulation.* The pulse was 140 in the minute, and the pulsations irregular in their succession and unequal in their power. For instance, during the full and hurried respiration the pulse was quick and strong; but during the time the respiration ceased, which was for the space of five seconds, the pulse became slow and feeble, and would almost cease; but the moment the long inspiration occurred, it would suddenly become full and strong, and increase in rapidity during the first three or four respirations, and then would diminish in frequency during the remaining more feeble respirations and during the intermission or interval, at the termination of which the pulse would be almost gone. This was the character of the pulse for the half hour I was with the child. The sound and impulse of the heart were evident over the largest portion of the front part of the chest. The carotid arteries beat freely and with vigour. On applying my ear to the child's head, I at once observed a very loud and strongly marked bellows-sound. It was much more distinct and rapid than the sound of respiration. It corresponded in frequency and was synchronous with the action of the heart, and with the impulsive motions observed in the unclosed fontanelle. It varied in frequency and in strength with the frequency and strength of the arterial pulse. It was loudest and most distinct during the two or three arterial pulsations which immediately succeeded the intermission of the respiratory movements, and during the long and deep respirations which followed the interval of repose. The bellows-sounds were then distinct from each other, but as the respirations and arterial pulsations became more frequent and feeble, the sounds ran into each other, constituting almost a continuous murmur. They could be heard very distinctly in every region of the head, the frontal, parietal, temporal, occipital, or on whatever part the ear might be

placed; but the *bruits* appeared loudest and most powerful when the ear was applied immediately over the anterior fontanelle—in fact, they were readily distinguished by the ear when removed to the distance of three inches from the fontanelle. The character of the sound varied somewhat in different portions of the head:—at the fontanelle it corresponded to the pure bellows-sound as described by Laennec, and was there distinguished by a peculiar softness and diffusiveness; but beneath the solid cranium it was coarse or harsh, approaching to the character of the sound of the saw or rasp. It seemed to arise out of the bone itself, and not to come from a distance. Over the sincipital and upper portion of the occipital region of the head, the sound was peculiarly distinct, and during the rapid respirations and arterial pulse it was characterized by a sort of musical murmur; and during the slow respirations and pulsations of the arteries, the sound seemed to be playing immediately beneath and against the inner surface of the ossified cranium over which the ear was placed, and resembled very strikingly the sound which may be produced by gently rubbing the inner table of the cranial bone with the finger whose cuticle is thick and rough. The sound varied in force with the varied power of arterial action.

During my examination of the patient, I made the following experiments:—Whilst my ear was applied to the head of the child and attentive to the bellows-sound, I made a gentle pressure upon the distended fontanelle with my fingers, and the sound gradually changed from the soft, diffusive *bruit de soufflet*, to a coarse, short, rasp-like sound, becoming at the same time, and in proportion to the degree of pressure, less and less audible. Although the pressure exerted was at times very considerable, yet it did not cause the sound entirely to cease. This experiment I repeated a number of times with the same result. It produced a good deal of uneasiness in the child, particularly when the pressure was greatest, causing it to move its arms and head, and to groan and cry out. I embraced the occasion to repeat an experiment which I had made in previous cases. I compressed the carotid arteries by means of my fingers, while listening to the bellows-sound, and I observed that the sound would gradually cease while the arteries were under compression; and when the circulation of the blood in them was completely arrested, no bellows-sound could be detected in the head. This experiment I repeated three times in this case, and always with the same effect.

From this period, the child exhibited all the common symptoms of cerebral inflammation until the evening of the 2nd day of March, the fifth day after I saw it. The cephalic bellows-sound continued to be

heard with varied intensity until the day but one before the child expired. On the morning before it died, I made the following note of the symptoms which I observed:—March 2nd, 10 A. M. The child is lying senseless in its nurse's arms. Its eyelids are open, pupils immoveable, sight gone; respiration and pulse short and quick. Its hands and feet are spasmodically contracted and are turned inward; and the fingers of each hand are firmly bent upon the palm of the hands. The cephalic bellows-sound cannot be distinguished; it does not exist, or else it is completely masked by the noise of respiration. While searching for the bellows-sound, my ear being closely applied to the child's head, she uttered two or three sudden cries, and the sound of its voice seemed to come directly from the bones of the head and to enter my ear, and was distinguished by a peculiar sharp, metallic, ringing tone, unlike any sound which I have ever noticed by auscultating the head. From this period the child gradually failed, and died at 11 o'clock, P. M., after having experienced during the day severe and rigid spasms, and uttering many shrieks and piercing tones.

*Autopsy* of this child's head, which was alone examined, exhibited the following appearances:—Scalp thin but healthy. On tearing it from the cranium, blood oozed from numerous points of its cranial surface. The bones of the cranium every where healthy; dura-mater natural. On lifting the brain from its cavity and raising the dura-mater from its surface, a vast quantity of lymph was found deposited in layers over the organ, apparently within the arachnoidal cavity. At the base of the brain the deposit of lymph was extensive, increasing in depth from the optic nerves, where it existed in considerable quantity, backwards, so that the nerves at the base of the brain, the pons varolii, medulla oblongata, and a large portion of the cerebellum, were covered by a continuous layer of lymph one quarter of an inch thick. The lymph extended in a continued sheet upwards from the base over the anterior lobes of the brain, covering one-third of the whole upper surface of the hemispheres. It also extended down between the hemispheres anteriorly and between a few of the convolutions, but in not so thick a sheet as over the surface. The lymph was light coloured, having an exceedingly faint tinge of yellowish-green. At the base of the brain it had the consistence of soft-boiled egg. On the upper surface of the left anterior lobe it was like the white of an egg well boiled, its surface being perfectly smooth and polished, as if covered by an exceedingly delicate membrane. The arachnoid and pia-mater appeared well enough, the vessels of which did not appear much engorged. The convolutions of the brain were somewhat flat-

tened, and the organ itself was rather soft and moist. The white portion of the left hemisphere posteriorly was of a decidedly reddish-grey colour, and the whole of both hemispheres had a tinge of the same. The lateral ventricles contained from two and a half to three ounces of perfectly limpid serum; the septum lucidum of good consistence; the fourth ventricle contained perhaps one-third of a tea-spoonful of thin pus of the same colour as the lymph. The spinal marrow was surrounded by lymph as far down as could be seen from the cavity of the cranium.

*Fourthly, I have found the cephalic bellows-sound to accompany suppuration of the brain, as in the following case.* William Doughty, aged three years, has been troubled for more than twelve months with sores in his ears, attended at times with a discharge of offensive matter. The affection of the ears was supposed by the parents to have been the result of the measles. During the last two or three months the discharge from the right ear has been copious and very offensive, and the child has been unusually fretful and peevish. Four days since, he appeared more unwell than usual, and has since exhibited considerable febrile excitement. He referred his suffering to his right ear, and has manifested great irritability, rolling his head frequently from side to side over his pillow, and occasionally crying out suddenly while asleep. At the present time, November 1st, 1833, he presents most of the symptoms now described, and is so exceedingly irritable that he will not allow me to examine him without much trouble. His countenance is expressive of much suffering; his respiration is hurried; tongue coated; bowels free, but dejections are of a dark colour; pulse 132 in a minute, and rather hard. He is so irritable and restless that I find it impossible to examine him by means of auscultation; he will not permit me to apply the stethoscope or my ear to his chest. This cavity, however, sounds well on percussion, and its movements are apparently free. The symptoms, so far as they can be studied, seem to indicate that the head is the principal seat of the affection. Leeches were applied to the temples, and small doses of calomel and chalk were prescribed to be taken every four hours.

November 2nd. The effect of the leeches and powders was favourable, and the child slept considerably during the night. His sleep, however, was disturbed, and he cried out suddenly, and had during the night what his mother called ague fits. At present his symptoms are nearly the same as yesterday. He may be somewhat more calm, however, and less refractory; the respiratory murmur is normal in upper part, but is obscure in lower portion, of the lungs; he, however, is still so restless and irritable, that no satisfactory auscultic examina-

tion can be made. The powders were ordered to be continued, and vesication of the scalp was prescribed by means of strong tincture of flies.

November 23d. The child passed a restless night, and had frequent ague fits. These he seemed to anticipate; for before they came on, he would complain of being cold, fold his arms, ask for more clothes, or to be carried to the fire. These ague turns were immediately preceded by paleness of face, great coldness of surface; and during their existence he would groan and scream out. They lasted commonly twenty or thirty minutes. His pulse are 140 in a minute, and hard; and he now exhibits more evident symptoms of pulmonary affection. His respiration is shorter, and inspirations are less deep; the movements of the chest, however, are quite free. In consequence of his great irritability and restlessness, auscultation does not communicate any satisfactory information. The chest, on percussion, resounds quite well, except in inferior portions, where it is, I think, less sonorous than natural. He has a light cough, but no expectoration; his breath is offensive, or else the offensive smell noticed arises from the matter which flows from the right ear. His head is hot, and the arteries of the neck and temples are seen to pulsate with great activity and energy. His vision is perfect, and there is no apparent alteration in the appearance or action of the pupils. On applying my ear to his head, which I am now able to do for the first time, I distinguish a very distinct bellows-sound. It varies in strength in different parts of the head, and is very audible during a momentary suspension of respiration. It is synchronous with the heart's pulsations, and with those of the temporal and carotid arteries. *Diagnosis*—principal and most serious difficulty is in the head, but there is also some disease of an inflammatory kind in the chest. R. Vesicate the scalp more extensively; continue powders; and apply a mustard poultice to the sides and posterior parts of the chest.

November 25th. During the last two days the child has exhibited the same general symptoms. He has had a number of severe ague fits, which, according to the report of his mother, resembled the ague fits of intermittent fever. They usually lasted from twenty to thirty minutes, and were succeeded by a disposition to sleep. The bellows-sound in the head continues to be heard very distinctly over the top of the head, but it is much the loudest at the sides and over the temporal bones near the ears; at times it passes into a continuous murmur. From this period until the 5th day of December, he manifested great uneasiness; sleeping but little, frequently crying out during sleep, and exhibiting more decided symptoms of pectoral as well as



cerebral disease. The usual remedies were administered to combat these symptoms, with varied effects. At times the child would amuse himself with his toys; but his strength continued to fail. The discharge from his right ear continued to the last, and was purulent and offensive; and two days before his death the discharge was composed mostly of blood, copious and extremely fetid. The cephalic bellows-sound was evident until twelve hours previous to his death, when it could be no longer heard. It decreased in distinctness as the child failed in strength and the arterial pulse became feeble; and during this great prostration of the physical powers it was sometimes difficult to distinguish the bellows-sound from the sound of respiration—the latter, in consequence of its rapidity, often masking the former. At no time previous to the last day of his sickness did he exhibit any loss of vision, the pupil of each eye being always contractile and natural. A few hours before his death he ceased to discern objects, the pupils being unaffected by the stimulus of light. He breathed with embarrassment, and with the “death rattle;” the cephalic bellows-sound could not be detected; the pulse at the wrist ceased, and the child died, after experiencing some partial spasms of the limbs and muscles of the neck and face.

The following were the pathological conditions of the head and chest of this child thirty hours after death.

The scalp and cranium healthy; the dura-mater and the other membranes of the brain free from disease; no unusual turgescence of blood-vessels; no effusion of serum between the membranes or over the upper surface of brain; the brain itself rather soft; several small abscesses were found in its substance on being sliced—one was discovered in the right corpus striatum, one in the right optic thalamus, and one in the most anterior portion of the posterior lobe of the brain. These three abscesses were each of the size of a large cherry. Besides these, five or six smaller ones were found in different parts of the cerebrum. These abscesses seemed to have a strong predilection for the grey substance, being in almost every instance entirely confined to it; and when they did encroach upon the medullary substance, they did so to an exceedingly small extent. True pus was found in these abscesses, sometimes unmixed, but oftener mixed with grumous blood. The abscesses contained no indurated walls; on the contrary, the cerebral substance around them was softer than natural. Very little, not more than  $\frac{3}{4}$ i. of clear serum was found in each lateral ventricle; some serum, however, was constantly flowing out from between the inferior portion of the cerebrum and tentorium during the examination, and about  $\frac{3}{4}$ i. was found at the base of the brain. The right

lateral sinus, just before it passes out of the skull, was greatly diseased. A portion of its coats appeared to have been mostly or quite destroyed, and replaced by half organized lymph, or perhaps what appeared like lymph was the tissue partially gangrened. It seemed as if a slight jar given to the body during life would have caused a rupture of the sinus into the arachnoidal cavity. On raising the dura-mater from the petrous portion of the temporal bone, the bone was found of a dark greenish colour, but neither softened or carious. The external meatus of the ear being cut open, a kernel of coffee was found closely impacted as far in as it could have been driven, and surrounded by a bed of soft cheesy secretion. It was quite black, and its inner extremity somewhat swollen. No trace of the tympanum or the small bones of the ear could be discovered.

*Thorax.* The pleura healthy. In the lungs were found a number of abscesses, varying from the size of a cherry to that of a small bullet; these were filled with thick pus, mixed with grumous blood, which had almost a fœcal smell. Some of the abscesses approached quite to the surface of the lung, and were decidedly gangrenous. In some small portions the pulmonary substance was firmer and more condensed than natural, as if affected with a degree of peripneumonia. No tubercles found in any part of either lung. The abdominal organs in a healthy state.

*I will state, fifthly, that the cephalic bellows-sound has been noticed in cases of induration of the brain with slight effusion into the ventricles and at the base of the organ.* In the night of the 22nd of January, 1833, I was called suddenly to visit Mrs. S., aged twenty-seven years, who had been attacked while asleep with severe convulsions. I learnt that this lady had, for more than two years, been subject to severe palpitations of the heart, which for the last few months had prevented her from using any laborious exercise. During this period her face and limbs became much bloated, and she suffered much pain in the head, and complained of ringing or musical sounds in the ears. On the evening previous to my visit, she retired to bed as well as she had been for some time past, and rested as well as usual, until about one o'clock, when she uttered a sudden and piercing scream, awakening her husband, and became severely convulsed. The spasms continued for about twenty minutes; on recovering from them she complained of oppression about the heart, and of a loud musical sound in her head. The sound she described as delightful, and its tones musical and harmonious; to use her own expression, "the music is beautiful, heavenly." At this moment I applied my ear to the top of her head, and heard a full, well characterized bellows-sound, cor-

responding with the heart's pulsations. The sound was loud, prolonged, diffusive; and while she held her breath for a moment, it passed into a momentary whizzing murmur. The lungs exhibited no signs of disease; the action of the heart was somewhat tumultuous and irregular, and its impulse powerful and heard over a good portion of the chest; the organs of digestion and secretion healthy; mind active and apparently unaffected. Notwithstanding the remedies which were prescribed, she continued to complain of the same symptoms and to suffer spasmodic convulsion a number of times a day for seven days, when she died. On examining the body, thirty hours after death, the lungs were found to be healthy, and a small quantity of serum was deposited in the cavity of the pleura. The heart was greatly enlarged and adhered firmly to the pericardium; its cavities were filled with coagula, and were somewhat dilated; the aortic valves were thickened and rigid; the remaining valves of the organ were healthy. On extending the examination to the head and dividing the cranium, the dura-mater was found to be thickened in various spots; the convolutions of the brain somewhat flattened, and here and there covered with thin layers of lymph. The brain was exceedingly firm and hard, and could be handled and rolled about without deforming it; it cut up like stiff putty, and exhibited a fibrous structure throughout; the fibres could be traced from the central part even to, and into the cortical substance of the organ; the ventricles contained a small, rather more than the usual, quantity of fluid, and about an ounce was found at the base of the brain.

I have noticed the cephalic bellows-sound in one other case of induration of the cerebral substance with slight effusion. The subject was a child aged two years, who had suffered severely from hooping cough. I saw it on the 2nd day of February, 1835, the day before it died, and noted the following symptoms: The bellows-sound in the head distinct, synchronous with the pulse; can be heard by applying my ear over any part of the head, but most distinctly when I apply it over the top or at the sides of the cranium. The sound is rather abrupt and rasp-like, not continuous. In this case the brain, on examination after death, was found to be much flattened in its convolutions, and its blood-vessels, external and internal, were highly congested. The brain was exceedingly hard and firm; it resembled soft putty in consistence, and could be handled and rolled about without being torn or even misshaped. No fluid was deposited in the ventricles, and only a very small quantity was found at the base of the organ.

I might, gentlemen, cite a number more of cases of cerebral disease (supposed to be such by the rational signs) in which the cephalic bel-

lows-sound was a prominent symptom; but as some of the patients recovered, and as no autopsy was made of those who died, I shall not tax your patience with a history of their malady. I will remark, however, in this connexion, that in a few cases which were supposed to be acute inflammatory affections of the cerebral organs, the cephalic bellows-sound appeared and disappeared two or three times during the course of the disease, and that its developement and disappearance seemed to depend on the increase and diminution of the inflammatory symptoms.

I cannot close my account of cases in which the cephalic bellows-sound was present, *without remarking, in the sixth place, that the sound has been produced by immediate pressure of the brain.* This is an interesting fact in the history of this new auscultic phenomenon; as we may derive from it some positive proof in relation to the immediate cause of the sound. I made a verbal report of this case to the Society at the time my observations were made; and I beg your attention to the case at this time. On the 24th day of June, 1834, a carpenter, while engaged in raising the frame of a church in Milton, had his skull badly fractured by the falling of a heavy iron bar upon it. The fracture was extensive, and eleven pieces of bone were removed from the wound, leaving an opening equal to one and a half inches in diameter, through which the brain was seen pulsating. In three or four days a portion of the brain protruded through the opening to the height of an inch or more above the cranium, forming a tumour of the size and shape of the large end of an egg. At this time, and while the tumour was in this condition, I applied my ear to the patient's head, and at the same time pressed the tumour with the palm of my hand, and caused it to sink back into the cranium. When the tumour was thus forcibly pressed, I heard a very distinct bellows-sound, and on taking off the pressure, the tumour would rise up again, and the bellows-sound would disappear. In fact the sound could be produced and made to disappear at will, by increasing and diminishing the pressure made upon the tumour. The sound was not developed until the tumour was pressed down nearly to the surface of the cranium. When first heard the sound was faint, soft, diffusive; but when the pressure was the greatest, and the tumour reduced almost to a level of the cranial surface, the sound was loud, short, abrupt. This experiment I performed a number of times, and with the same results. When the pressure was considerable, the patient complained of pain in the head; but the severest pressure which was made upon the tumour, did not deprive him of sensation or cause him any considerable degree of suffering. This man finally recovered from the

effects of the wound, and has returned to his native country in Europe.

I have now, gentlemen, laid before you a portion of the observations which I have collected and recorded in relation to the cephalic bellows-sound. This new auscultic symptom, which was a prominent one in the cases I have cited, is not a phenomenon of health. It cannot be detected in the heads of children or adults who are free from all disease or derangement of the bodily functions; while on the other hand, as the cases above related have shown, it has been found to accompany, 1st, *chronic hydrocephalus*; 2nd, *congestion of the cerebral organs*; 3d, *acute inflammation of the cerebral organs with serous effusion in or around them*; 4th, *abscesses in the brain*; 5th, *induration of the brain with effusion into its ventricles and at its base*; 6th, *compression of the brain*. We have then one auscultic sound in the head which is a symptom of cerebral disease; and it is possible that the cephalic sounds of the voice and deglutition, as well as that of the heart, may also have been modified or altered in the same cases. I regret I did not devote more attention to these sounds, in order to ascertain the fact. Whether any alteration in the last named normal cerebral sounds takes place or not, that which I have described under the name of cephalic bellows-sound accompanied, and was unquestionably dependent on, a pathological condition of the organs within the cranium. The whole history of the cases proves this; and we come now to a consideration of its seat and immediate cause; or in other words, to inquire, 1st, In what organ or organs did this sound originate in the instances above mentioned? 2ndly, What part of the cranium did it proceed from? and 3dly, What was the immediate or proximate cause of its production? My views in relation to these points were expressed in my first communication, and remain unchanged. In regard to the organ or organs in which the sound had its origin, it is very evident, I think, from a consideration of the symptoms in the cases which have been cited, and the circumstances attending them, that it originated and was seated *in the arteries*. For in the first place, the sound was distinct from that produced by respiration, by deglutition, or any other operation going on within the head, that we can conceive of, save arterial action. Secondly, it was synchronous with the pulsations and impulse of the heart and of the carotid and temporal arteries, and also with the rising and impulse of the brain, as observed by placing the finger upon the unclosed fontanelle. Thirdly, the sound ceased, or at any rate was rendered inaudible, by compressing the carotid arteries and arresting the circulation of the blood through them; and it became fainter and less distinct as

the patient grew weak and the arterial action feeble. Fourthly, it resembled in all respects the *bruit de soufflet* which we hear in diseases of the heart and of the arteries; and like that, it often passed into a continuous murmur, and was characterized at times by a musical tone. Fifthly, in studying the structure, distribution and functions of the organs enclosed by the cranium, we must, I think, be convinced that the arteries were the only organs which could have emitted a bellows-sound like that I have noticed.

Assuming it as proved, then, that the sound in question proceeded from the arteries, I may further observe that those situated at the base of the brain were probably the ones in which it originated. I infer this from a consideration of the peculiar distribution of the arteries within the head. Anatomy teaches us that all the arteries of any considerable size are situated at the base of the brain, and rest on unyielding bony structure. Having passed through their appropriate apertures and osseous canals, they course along upon the base of the skull and in furrows formed for them in the brain, and soon subdivide and spread themselves upon the pia-mater, and do not actually enter the substance of the brain until they become mere capillary vessels. There is, therefore, no artery entering the cerebral substance, and no one running over its surface, of sufficient calibre to render it capable of sending forth a bellows-sound as loud and audible as were those which characterized the above cases. For to produce a bellows-sound in an artery artificially, which can be readily done, I find that the artery must be of considerable size, and must rest upon or be in contact with a surface which is solid or somewhat unyielding; otherwise it will not be in a condition required for the developement of the sound. Such is the size and the situation of the arteries on which the brain rests. A still further proof that the arteries at the base of the brain were the seat of the phenomenon, is derived from the existence of the pulsatory motions of the brain which were seen and felt at the fontanelle. These motions, it is very evident, were given to the brain by the action of the arteries on which the brain rested; no other function but that of the arteries could have caused these motions. The cephalic bellows-sound always accompanied and was synchronous with the pulsatory motions of the cerebral mass; consequently it follows that the sound must have proceeded from those vessels. The facility with which it was heard at the summit of the cranium is no evidence against the validity of this conclusion; for the brain is an excellent conductor of sound, as is proved by the fact that it readily transmits the noise produced by the action of a watch which may be in contact with the side of the head opposite

that on which the auscultator's ear is applied. If, then, the bellows-sound proceeded from the arteries at the base of the brain, its production in the cases above related, may be rationally and satisfactorily accounted for. It is now a well established fact, that the bellows-sound of the heart and of the arteries arises from an impediment to the flow of the blood through these organs. An impediment to the free passage of the blood through the large arteries which lay on the base of the skull, must, I conceive, have existed in these cases. For the brain is contained in a strong and unyielding bony case, and is itself incompressible. In all the cases in which the cephalic bellows-sound was heard, or at least in all those in which it was heard and of which an autopsic examination was made, there was fluid, congestion of blood-vessels, or a pathological state of the organs within the cranium which would, and must have, displaced the brain, and forced it against the compressible arteries on which it rested. The arteries being thus forced and pressed against the bony channels through which they coursed, their calibre must have been diminished. This condition of the arteries formed an impediment to the free passage of blood through them, and constituted the immediate or proximate cause of the cephalic bellows-sound.

This is, I believe, the true rationalé of this new auscultic symptom, the only theory by which its production can be satisfactorily accounted for. It will, moreover, enable us to account for all the variations in the intensity and tone of the sound under consideration, and also for the occurrence of many other symptoms attendant on diseases of the brain, such as the sudden screams uttered by children, spasms, noises in the head, &c., all which would naturally result from the different degrees of force with which the brain was urged against the arteries and nerves which lay beneath it.

Having now offered what I have to say at this time on the subject of the cephalic bellows-sound, I will ask your attention for a moment to one more abnormal cerebral sound, which is likewise connected with the cephalic sound of the heart. In the course of the last three years, I have noticed a modification of the normal cephalic sound of the heart in six cases of cerebral apoplexy. In each of these cases the sound of the heart, as heard at the surface of the cranium, was decidedly abnormal. Instead of its being soft, and appearing as if it proceeded from a distance, as in healthy adults, it seemed to be near the ear, and was characterized by a kind of impulse, as if the whole brain was suddenly raised up against the calvarium. So characteristic did this sound appear, I could not but believe that the brain *en masse* did actually strike against the cranium beneath my ear.

Five of the individuals in whom I noticed the phenomenon died, and an autopsic examination was made of two of them. A brief history of these two cases may not be uninteresting.

In the afternoon of the 14th day of September, 1835, Miss T., aged seventy-one years, was suddenly attacked by apoplexy, which deprived her of consciousness and of the power of motion in the right half of the body. I was with her in a few minutes after the accident, and bled her freely from the arm and prescribed other remedies. In two hours I visited her again, and found her as unconscious and as helpless as on my first visit, and exhibiting all the symptoms which usually result from a sudden and copious effusion of blood into or upon the brain. At this time I applied my ear to her head, and detected nothing resembling a bellows-sound, but I heard the action of the heart very distinctly, or rather the first beat of the heart. The sound did not appear to be at a distance, as is usual in a healthy state of the brain, but it seemed to be in the head itself, and was accompanied by an impulse which actually gave motion to the head. It seemed to me as if the brain itself was suddenly raised up against its bony case at each beat and sound of the heart. I could not separate the cephalic sound of the heart in this case from the idea of an impulse being connected with it. I therefore characterized it at the time as an impulsive sound. The patient for two days rallied a little, but soon relapsed, and finally died the fifth day after the attack. On a post-mortem examination of the head, the membranes of the brain were found to be healthy; the convolutions of the brain flattened; the brain itself of natural consistence and colour. On dissecting the brain a large deposit of partially coagulated blood was found in each hemisphere: in the right hemisphere it amounted to two ounces or more, and the cavity which contained it extended the whole length of the lateral ventricle; in the left hemisphere the blood was deposited along the ventricle, and amounted to about one ounce and a half, and had forced its way into the left lateral ventricle. No appearance of disorganization of the cerebral mass was discovered, except in the immediate vicinity of the hemorrhagic deposits, around which the brain was somewhat discoloured and softened. The arteries at the base of the skull were undergoing the process of ossification, were white, opaque, and inelastic. The carotid arteries, where they entered the cavity of the cranium, were so much ossified as to be stiff, and to break under pressure.

In the following case, the impulsive cephalic sound of the heart disappeared after copious venesection and as soon as the patient recovered from the apoplectic state; and it is this fact which renders the



case worthy of reciting. Mrs. B., aged sixty-one years, had an attack of apoplexy on the 4th of March, 1835, which felled her to the floor, paralyzed the right side, and deprived her of consciousness. In the course of a few months she had recovered almost entirely from the effects of this attack, and was able to walk and to enjoy life as usual until the 14th day of April, 1836. On rising from her bed on that morning, she experienced another attack of apoplexy, which affected her as before, except that it did not deprive her of consciousness. I saw her in ten minutes after the attack, and on auscultating her head, I noticed a strong impulsive sound accompanying the action of the heart, as if the brain was suddenly propelled up against the cranium beneath my ear. The sound appeared to be near my ear, and resembled almost exactly the sound which I caused by snapping forcibly with the finger nail my cheek when powerfully distended with air. I bled this patient freely, and ordered ice-water to be applied over her head. In three hours I visited her again, and was gratified to find that she had recovered so much as to be able to speak and to move her limbs. On applying my ear to her head at this time, I could hear nothing of the impulsive sound which I had before noticed. I could detect the cephalic sound of the heart, but it had nothing of the impulsive character, and seemed to be at a distance, instead of being immediately beneath my ear. In twelve hours after the attack my patient could speak and use her limbs nearly as well as she could previously to the accident. She, however, began to lose her strength in the course of the year, and continued to fail both in body and mind until the 4th day of September, 1837, when she died. An examination of the head was made the next day. The brain was found to be rather soft than otherwise. No alteration was found in the substance of the brain, except in the left optic thalamus; this body was much shrunken, and in it was discovered the remains of an hemorrhagic effusion. The cavity in which the blood had been deposited was small, irregular in form, and of a dull yellow colour, and was entirely empty.

I might cite one other case of cerebral apoplexy in which the impulsive sound was heard at the time of the attack, and which disappeared as the patient recovered from it; but I will not consume your time by describing it. My object has been gained by announcing the discovery of this abnormal sound, and by introducing it to your notice. The sound, I am aware, will not be easily detected and recognised by one who has had no experience in cerebral auscultation; but having made himself familiar with the normal cephalic sounds, and particularly with the cephalic sound of the heart, the auscultator will meet

with little or no difficulty in distinguishing the impulsive sound under consideration, when he auscultates the heads of those labouring under cerebral apoplexy. I have heard it in every case of the affection in which I have practised cerebral auscultation, and from this fact I am strongly inclined to believe that it is a constant symptom of the disease.

Indeed, when we consider the condition of the brain and of the arteries at its base, resulting from an extensive effusion of blood within the cranium, we may readily conceive that such a symptom would necessarily be developed. The moment such an effusion occurs, the brain is suddenly pressed down upon the arteries on which it rests, and also against every point of its bony case. It cannot then, for want of room, rise and fall with the pulsations of the arteries at its base, as it does in its natural condition; and this being the case, the mass of blood thrown from the heart at each contraction of its left ventricle, would strike with great force against the compressed parts of the arteries, and communicate a shock to the brain which would be transmitted to, and be heard as an impulsive sound at, the surface of the cranium.

With these observations I conclude for the present my remarks on cerebral auscultation. The facts which I have submitted to your notice are of a character hitherto unobserved. They must be regarded as highly important, as they cannot fail to lead to a new method of investigation of cerebral diseases.

*Boston, April, 1838.*

ART. II. *On some Mechanical Functions of Areolar Tissues.* By JOHN W. DRAPER, M. D., Professor of Chemistry and Physiology in Hampden Sydney College, Virginia.

1. It is the object of this communication, to offer some proofs that the peculiar force known to chemists and physiologists under the title of endosmose and exosmose, has no existence; and that all the cases described as chemical decompositions, brought about by the intervention of animal membranes and areolar tissues, are only deceptive examples of the play of ordinary and well known agents.

2. It is necessary, before entering into a critical examination of these points, to explain briefly the leading experiments which have been reported in connexion with the subject. Often received upon doubtful evidence, and sometimes implying the existence of laws,